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GAGINGS OF SEWAGE FLOW AT LAWRENCE, KAN.

By W. C. HOAD and A. H. MANN, University of Kansas, Lawrence.

THE following is a report of research work undertaken by Mr. A. H. Mann, an engineering senior at the University of Kansas, the work being done under the direction of Prof. W. C. Hoad. The report is written by Mr. Mann.

Very little investigation of the actual rates of flow of sewage in cities and towns has been made where this flow was observed continuously and for a considerable period. With the exception of one set of gagings made on two main sewers in Des Moines, Iowa, the writer was unable to find any record showing that gagings have been made in this manner and on a large amount of sewers.

These gagings at Des Moines were made by J. A. Moore and W. J. Thomas, class of 1895, Iowa Agricultural College. Two main sewers were gaged continuously for fifteen days.

The gagings at Lawrence were made in order to obtain a record of the continuous flow of sewage from a purely residence district and for a considerable length of time.

The conditions at Lawrence are especially favorable for this work, as the city has separate systems of sewerage, and all the sanitary sewers empty into the same outflow sewer. Another advantage for getting a record of the flow of house sewage is the fact that there are few factories in Lawrence, and these are near the river and have private sewers.

There are about 17.9 miles of sewers in Lawrence, ranging in sizes from eight inches to twenty-one inches in diameter.

Gagings were made on the main outflow sewer at the intersection of Pennsylvania and Henry streets, this place being chosen because the entire sanitary sewage of the city passes that point. Continuous gagings were made for thirty days.

Gagings were also made on the main sewer at the intersection of Quincy and Connecticut streets, so that the flow from the purely residential district could be studied. These gagings extended over a period of thirty-eight days, beginning a short time before and continuing during the same time as those on the main outflow sewer. The gagings were made during the months of March and April, 1906, and the rainfall was about the average for this section of the country. At times of heavy rains a large amount of rain-water reaches the sewers directly through manhole and flushtank sewers and from house roofs, as is plainly shown by the rapid rise in the flow-diagram curves whenever it rained while the gagings were being taken. As the main outflow sewer empties into the Kaw river below the surface of the water, it was necessary to make the gagings in manholes. The apparatus used consisted of a right-angled triangular weir placed in the sewer, and a device for continuously recording the head of the water above the weir. The recording device was placed three feet from the weir, on the upstream side. The weirs were gaged in the hydraulic laboratory of the Kansas State University, with the water admitted in a manner similar to the way that it would reach the weirs in the sewers. The weirs were placed in the sewer where that leaves the manhole. A bicycle tube was used for packing around the weirs. When in place the bicycle tube was pumped full of air and made a water tight joint. The apparatus that recorded the height of the water consisted of a cylinder about four inches in diameter and twelve inches long, which was run by a clock. A pencil fastened to a rod extending up from the float recorded the height of the water over the weir on a record sheet placed around the cylinder.

The records were then reproduced on drawing paper by tracing them over carbon paper, so that each day's curve was superimposed on all preceding curves. From the entire series of plotted curves a single curve representing a general average could be inferred graphically. Individual curves show a number of small fluctuations, probably due to the emptying of flush-tanks. Some large fluctuations, due to a weekly emptying of a large swimming-pool, showed both the accuracy and sensitiveness of the recording apparatus. The following results were obtained:

The maximum rate of flow for the main outflow sewer and the Connecticut Street sewer were, respectively, 206 gallons and 226 gallons per capita per day, but as these were during heavy rains, they do not mean much in this work.

The maximum dry-weather rate of flow for the main outflow sewer was about 130 gallons per capita per day, and occurred between nine and ten o'clock A. M. The minimum rate of flow for the main outflow sewer was 56 gallons per capita per day, and occurred at about four o'clock A. M.

The maximum dry-weather rate of flow for the Connecticut Street sewer was about 150 gallons per capita per day, and occurred between eight and nine o'clock A. M.

The average rate of flow for the Connecticut Street sewer was 82 gallons per capita per day. The average rate of flow for the main outflow sewer was 85 gallons per capita per day.

The number of people using the sewers was obtained by counting the houses on the blocks reached by sewers and multiplying by six. This gives 8400 as the number of people using the sewers. Comparison was made with the amount of water used for domestic purposes, which was estimated at 107 gallons per capita per day, and which the writer believes is rather high, because some of the data used to get these figures seemed somewhat indefinite.

If 85 gallons be taken as the number of gallons of sewage per capita per day, and 107 gallons per capita per day taken as the amount of water used, the sewage flow is found to be about eighty per cent. of the water consumption.